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(54) [TITLE OF THE INVENTION] EXPOSURE APPARATUS

* Page count is for the Japanese original text.

[CLAIMS]

[Claim 1] An exposure apparatus comprising a first chamber in which an exposure processing section and a substrate transport section are accommodated while being substantially shielded from an outside air, the exposure processing section being provided to transfer a pattern formed on a mask onto a photosensitive substrate, the substrate transport section having at least one holding member capable of holding the photosensitive substrate, and the substrate transport section loading the photosensitive substrate held by the holding member to the exposure processing section and loading the photosensitive substrate, to which an exposure process has been performed in the exposure processing section, to the holding member;

the exposure apparatus characterized by comprising:

a second chamber in which at least the holding member holding a photosensitive substrate to be loaded to the exposure processing section is accommodated, separately from the first chamber, while being substantially shielded from the outside air; and

a control means for controlling an environmental condition around the photosensitive substrate held by the holding member accommodated in the second chamber.

[Claim 2] The exposure apparatus according to claim 1, characterized in that the control means controls at least a temperature of a gas in the second chamber and

includes a gas circulation means for causing the gas, at least the temperature of which is controlled, to flow substantially along the photosensitive substrate held by the holding member.

[Claim 3] The exposure apparatus according to claim 2, characterized in that the control means controls the temperature of the gas in the second chamber based on a temperature of the photosensitive substrate arranged in the exposure processing section in the first chamber or a temperature around the photosensitive substrate arranged in the exposure processing section in the first chamber.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[INDUSTRIAL FIELD OF THE INVENTION]

The present invention relates to an exposure apparatus for producing a semiconductor element, a liquid crystal display element, etc., and in particular to an apparatus for controlling an environmental condition in a chamber in which the exposure apparatus is accommodated while being substantially shut off or shielded from an outside air.

[0002]

[CONVENTIONAL ART]

In recent years, in a lithography step of producing the semiconductor element and/or the liquid crystal display element, a projection exposure apparatus (stepper) based on the step-and-repeat system is frequently used as an apparatus which transfers a pattern of a mask or reticle (hereinafter referred to simply as "reticle") onto a photosensitive substrate (a semiconductor wafer or glass plate formed with a resist layer on a surface thereof). For example, in the stepper for producing liquid crystal display element, images of patterns which are formed on a plurality of reticles respectively are transferred onto the glass plate and subsequently composed or stitched (in a stitching manner) via a projection optical system at the x1 magnification, while exchanging the reticles and subjecting a plate stage to the stepping movement. Accordingly, it is

possible to form a circuit pattern having a large area which is formed by image composition (stitching) on the glass plate.

[0003] This type of stepper is constructed of an exposure processing section having a projection optical system which forms an image of a reticle pattern and projects the image of the reticle pattern onto a glass plate, and a plate stage which is two-dimensionally movable in an imaging plane of the projection optical system while holding the glass plate; and a substrate transport section which has at least one holding member capable of holding the glass plate, which loads the glass plate held by the holding member to the exposure processing section, and which loads (unloads) the glass plate, to which an exposure process has been performed in the exposure processing section, to a holding member which is the same as or different from the at least one holding member. The holding member includes, for example, a carrier for plate-storage in which a plurality of glass plates (about 10 to 20 plates) can be accommodated; or a buffer cassette in which a glass plate is temporarily accommodated to adjust a cycle time of plate loading in a case that the stepper and a coater-developer are in-lined; etc.

[0004] In the stepper having the construction described above, the imaging characteristic of the projection optical system (focus position, projection magnification, etc.) may

vary depending on the change in environmental condition (atmospheric pressure, air temperature, humidity, etc.) around the projection optical system, and further depending on the change in temperature of the projection optical system due to absorption of exposure light by the projection optical system, and the like. Therefore, the entire apparatus (the exposure processing section and the substrate transport section) is accommodated in a chamber, which is controlled at a constant temperature (for example, 23 ±0.1 degrees Celsius) and at a constant cleanliness level (for example, class 10), while being substantially shut off or shielded from the outside air. In addition, the following technique is also suggested. That is, a fluid, of which temperature is highly controlled, is used to control the temperature of only the projection optical system significantly affecting the imaging characteristic, thereby making it possible to effectively prevent the imaging characteristic from varying or fluctuating.

[0005]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

In the conventional technique described above, the stepper is used in the chamber, the temperature of which is controlled with about ±0.1 degrees Celsius accuracy. In a case that the glass plate is loaded into the chamber, on a carrier basis or one-by-one, by hand or a substrate transport device, the temperature of the glass plate is

balanced to a temperature which is substantially same as the temperature in the chamber. However, the temperature of the plate stage (particularly, a holder) of the exposure processing section is balanced to a temperature which is different from the temperature in the chamber, due to the thermal energy which is conducted to and accumulated in the stage via the glass plate when the pattern is exposed onto the glass plate, due to the heat which is generated from a driving system of the plate stage (for example, a nut screwed to a feed screw in a case of a feed screw mechanism), or the like. Therefore, the temperature of a glass plate, which is taken out or unloaded from the plate carrier by the substrate transport device (plate loader) and is placed on the plate stage (holder) of the exposure processing section, continues to change until the temperature difference between the glass plate and the plate stage (holder) is substantially zero. Eventually, the temperature of the glass plate is balanced to the temperature which is substantially same as the temperature of the plate stage.

[0006] Accordingly, the size of the glass plate continues to change until the temperature of the glass plate is in the equilibrium state. Thus, in a case that the pattern exposure is performed with respect to the glass plate before the glass plate is in the equilibrium state, the following problem arises. That is, the stitching

accuracy of the reticle patterns on the glass plate or the overlay (alignment) accuracy of the projection image of the reticle pattern with respect to the pattern which has already been formed on the glass plate is decreased. In order to avoid the problem as described above, it is necessary to stop or pause the exposure operation until the temperature difference between the glass plate and the plate stage (holder) is negligible or is substantially zero (in other words, until the decrease in the stitching accuracy and/or the alignment accuracy due to the size change of the glass plate is within a predetermined acceptable value (a value determined by a pattern line width, etc.)). However, this stopping time causes another problem such that the throughput of the exposure apparatus is decreased.

[0007] The present invention has been made taking the foregoing circumstances into consideration, an object of which is to obtain an exposure apparatus which can prevent decrease in the throughput and/or decrease in the alignment accuracy (or stitching accuracy) due to the size change of a photosensitive substrate occurring until a photosensitive substrate in the exposure processing section is in the thermally equilibrium state.

[0008]

[MEANS FOR SOLVING THE PROBLEM]

In the present invention, in order to solve the

problem as described above, there is provided an exposure apparatus including a first chamber (main chamber) MC in which an exposure processing section PE and a substrate transport section PL are accommodated while being substantially shielded from an outside air, the substrate transport section PL being provided to transfer a pattern formed on a reticle R onto a photosensitive substrate (glass plate) PT, the substrate transport section PL having at least one holding member (plate carrier PC_1, PC_2) capable of holding the photosensitive substrate PT, and the substrate transport section PL loading the photosensitive substrate PT held by the holding member PC_1 to the exposure processing section PE and loading the photosensitive substrate PT, to which an exposure process has been performed in the exposure processing section PE, to the holding member PC_1 or PC_2, the exposure apparatus being further provided with a second chamber (sub chamber) SC in which at least the holding member PC_1 holding a photosensitive substrate PT to be loaded to the exposure processing section PE is accommodated, separately from the first chamber MC, while being substantially shielded from the outside air; and a control means (temperature adjusting unit 20, chamber controller 100) for controlling an environmental condition around the photosensitive substrate held by the holding member accommodated in the second chamber SC.

[0009]

[EFFECT]

In the present invention, the configuration is provided wherein the second chamber in which at least the holding member holding the photosensitive substrate to be loaded to the exposure processing section is accommodated, separately from the first chamber in which the exposure processing section etc. is accommodated, while being substantially shut off from the outside air; and the environmental condition (in particular, the temperature) around the photosensitive substrate accommodated in the second chamber can be arbitrarily controlled.

[0010] Accordingly, it is possible to set the temperature of the photosensitive substrate which is to be loaded to or into the exposure processing section (pre-loading temperature of the photosensitive substrate) to be substantially equal to the temperature of the stage (holder) in the exposure processing section. Therefore, it is unnecessary to stop the exposure operation until the photosensitive substrate in the exposure processing section is in the thermally equilibrium state, and thus it is possible to improve the throughput of the exposure apparatus without decreasing the alignment (or stitching) accuracy.

[0011]

[EMBODIMENT]

Fig. 1 schematically shows an overall construction of an exposure apparatus according to an embodiment of the present invention and shows the exposure apparatus which is accommodated in a chamber as viewed from above. As shown in Fig. 1, in this embodiment, the apparatus is entirely accommodated in two pieces of chambers MC, SC while being substantially shut off or shielded from an outside air. Main chamber (first chamber of the present invention) MC accommodates an exposure processing section PE including a projection optical system 7 provided to project and to image (perform image formation of) a reticle pattern onto a glass plate, and the like. Sub chamber (second chamber of the present invention) SC includes two pieces of plate carriers PC_1, PC_2. The sub chamber SC accommodates a substrate transport section (plate loader) PL which loads a glass plate, which is accommodated in the carrier PC_1 (or PC_2), to the exposure processing section PE and unloads the glass plate, to which an exposure process has been performed in the exposure processing section PE, to the carrier PC_1 (or PC_2).

[0012] In this embodiment, it is assumed that the glass plate, which is to be loaded into the exposure processing section PE, is accommodated in the carrier PC_1 and that the glass plate, which was taken out from the carrier PC_1 and to which the pattern has been transferred in the exposure processing section PE, is accommodated in the carrier PC_2

by the plate loader PL. Further, as shown in Fig. 1, an opening AP is formed at a part of the boundary between the main chamber MC and the sub chamber SC so that the glass plate can be transported between the main chamber MC and the sub chamber SC.

[0013] The plate carriers PC_1 and PC_2 are placed on support members EV_1 and EV_2, respectively; each of the support members EV_1 and EV_2 is movable in upward and downward directions, namely in the direction perpendicular to the sheet surface of Fig. 1. By moving the support member EV_1 (EV_2) downwardly, transfer (delivery and receipt) of the carrier PC_1 (PC_2) is performed between the support member EV_1 (EV_2) and a carrier transport wagon PW via a door SD_1 (SD_2). Further, in Fig. 1, there is arranged an environmental sensor 26 which detects environmental condition (air temperature, atmospheric pressure, etc.) in the sub chamber SC, particularly in this embodiment, the environmental condition around the plate carrier PC_1 which holds the glass plate to be loaded to the exposure processing section PE.

[0014] Note that in this embodiment, it is sufficient that only the temperature of the glass plate in the carrier PC_1 or the temperature around the glass plate can be detected. For example, it is allowable to provide such a configuration that the temperature of the glass plate (or the carrier PC_1) is measured directly or indirectly by a

temperature sensor. Further, in some cases, the glass plate in the plate carrier PC_2 is loaded to the exposure processing section PE. Thus, it is desirable that the environmental sensor is provided also in the vicinity of the carrier PC_2.

[0015] Fig. 5 is a perspective view of a specific construction of the plate loader PL. A glass plate PT in the carrier PC_1 is taken out therefrom in a state that the back surface of the glass plate PT is suction-attracted by a transport member (arm) 70. Each of a plurality of pieces of the glass plate in the carrier PC_1 is taken out from the carrier PC_1 with the transport arm 70 by moving the carrier PC_1 and the transport arm 70 relative to each other in the Z direction, namely in this embodiment, by moving the carrier PC_1 upwardly and downwardly with the support member EV_1 (Fig. 1).

[0016] The transport arm 70 holding the glass plate PT rotates 90 degrees in the XY plane. Then, the glass plate PT is aligned with respect to the transport arm 70 by a pre-alignment mechanism 71 which is provided associated with an arm rotating section (not shown). The pre-aligned glass plate PT is delivered to a load arm 73 via a delivery table 72 which is movable in the Z direction. After that, the glass plate PT is loaded, by the load arm 73, to a plate stage PS which stands-by at a predetermined position in the exposure processing section PE, and then the glass

plate PT is suction-attracted to the holder PH. The delivery table 72 is configured to be capable of delivering (transporting) the glass plate PT to the load arm 73 by rotating the glass plate PT 90 degrees when necessary.

[0017] The glass plate PT, to which the pattern has been transferred in the exposure processing section PE, is taken out (unloaded) by causing the transport arm 70 to enter to a position above or over the plate stage PS and then, if necessary, by rotating the glass plate PT 90 degrees on the delivery table 72, followed by being accommodated in the carrier PC_2 (Fig. 1). Note that it is allowable that a glass plate to be processed next to the glass plate may be previously held by the load arm 73 during the exposure operation of the glass plate, so as to quickly exchange the glass plates.

[0018] Next, an explanation will be given briefly about the construction of the exposure processing section PE, with reference to Fig. 4. Among the constitutive parts or components of the apparatus shown in Fig. 4, at least the projection optical system 7 and the plate stage PS are arranged in a chamber room MR. In Fig. 4, four reticles R_1 to R_4 are held by a reticle stage RS; and each of the reticles is set to be located above or over the projection optical system 7 by a laser interferometer 5 and a motor 6. Each of the reticles R_1 to R_4 is configured to be finely movable in the X, Y, θ (rotating) directions on the reticle

stage RS. Three pieces of reticle alignment systems 3X, 3Y, 3θ (regarding the reticle alignment system 3X, only a mirror 4X is shown) are used to finely move the reticles, respectively, thereby positioning each of reticles so that the center point of the pattern area to be transferred substantially coincides with an optical axis AX of the projection optical system 7.

[0019] An illumination light passing through the reticle R_2 comes into the projection optical system 7 which is telecentric on the both sides. The projection optical system 7 forms an projection image of the reticle pattern and projects the projection image, at the x1 magnification, onto the glass plate PT which has a resist layer formed on a surface thereof and which is held so that the surface having the resist layer substantially coincides with the imaging plane of the projection optical system 7. The glass plate PT is placed on the plate stage PS via the plate holder (not shown). The plate stage PS is configured to be two-dimensionally movable in a step and repeat manner by a motor 9. When the transfer-exposure of the reticle R_2 with respect to the glass plate PT is completed, the plate stage PS is stepped (step-moved) to a next shot position. The two-dimensional position of the plate stage PS is always detected at a resolution of, for example, about 0.01 μm, by an interferometer 8. Further, a temperature sensor 30 provided to measure the temperature of the plate stage

PS or of the holder is provided on the plate stage PS. Furthermore, the apparatus shown in Fig. 4 is also provided, for example, with an alignment system 31 of a TTL (Through The Lens) type as disclosed in Japanese Patent Application Laid-open No. S60-130742. A controller 50 not only controls the positions of the reticle stage RS and the plate stage PS, but also integrally controls the entire apparatus.

[0020] Returning again to the explanation of Fig. 1, the exposure processing section PE is disposed in the chamber room MR of the main chamber MC. The chamber room MR is surrounded by a HEPA filter 12, a partition (wall) 14, a return duct 15, etc. The environmental condition in the chamber room MR (in particular, the temperature) is controlled at a predetermined temperature (about 23 degrees Celsius) by controlling the temperature of a gas (air) in the main chamber MC and circulating the gas (air) with a temperature adjusting unit 10, a fan 11, a freezer or refrigerator 13, etc., which are provided in an air-conditioning machine room 17. In this procedure, a chamber controller 100 (Fig. 3) controls the temperature adjusting unit 10, based on, for example, a detecting result of an environmental (or temperature) sensor 16 disposed in the vicinity of the projection optical system 7, to thereby maintain the temperature in the chamber room MR at the predetermined temperature.

[0021] Arrows shown in Fig. 1 each indicate a direction (circulation route) in which the air flows in the main chamber MC; in the chamber room MR, the air flows substantially along the boundary between the main chamber MC and the sub chamber SC. The direction in which the air is allowed to flow in the chamber room MR may be any direction. However, as a matter of course, it is desirable that the air is not allowed to flow toward the sub chamber SC, that is, toward the opening AP. Note that the pressure of the gas, which is allowed to inflow into the chamber room MR, etc., may be controlled together with the temperature.

[0022] Next, an explanation will be made with reference to Fig. 2 about an example of the specific construction of the sub chamber SC. Fig. 2 shows the sub chamber SC shown in Fig. 1 as viewed in front thereof (viewed in a direction from the wagon PW). The plate loader PL is accommodated, together with the two pieces of plate carriers PC_1, PC_2 (not shown in Fig. 2), in a chamber room SR wherein the gas (air), of which temperature is at least controlled, is circulated via a HEPA filter 22 and the return duct 25. The environmental condition in the chamber room SR, in particular the temperature around the plate carrier PC_1 in which the glass plate to be loaded to the exposure processing section PE is accommodated, can be set to a predetermined temperature by controlling the temperature of

the gas (air) in the sub chamber SC and circulating the temperature-controlled air by a temperature adjusting unit 20, a fan 21, a freezer or refrigerator 23, etc., which are provided in an air-conditioning machine room 27. The chamber controller 100 (Fig. 3) controls the temperature adjusting unit 20, based on detecting result of the environmental (or temperature) sensor 26 and further based on detecting result of the temperature sensor 30 (as will be described later) disposed at the plate stage (holder) PS in the exposure processing section PE, to thereby set the temperature in the sub chamber room SR, in a similar manner with respect to the main chamber MC.

[0023] Arrows shown in Fig. 2 each indicate a direction (circulation route) in which the temperature-controlled air flows in the sub chamber SC; in the chamber room SR, the temperature-controlled air flows towards the return duct 25 from the boundary (opening AP) between the main chamber MC and the sub chamber SC. In the construction of this embodiment, the opening (entrance/exit opening of the glass plate) of the two pieces of plate carriers PC_1, PC_2 is substantially parallel to the direction in which the air flows in the chamber room SR. Thus, the following construction is desirable to improve the efficiency of the temperature control of glass plate(s) accommodated in the chamber room SR. That is, a plurality of holes (openings) are formed, for example, on a side surface portion (a

surface which is substantially vertical to the direction in which the air flows) of each of the carriers PC_1, PC_2 so that the temperature-controlled air is allowed to flow substantially along the glass plate in each of the carriers PC_1, PC_2. The direction in which the air is allowed to flow in the chamber room SR may be any direction. For example, the air may be allowed to flow from the carrier PC_1 to the carrier PC_2 in Fig. 1. However, it is desirable that the air is allowed to flow so that the air from the HEPA filter 22 is not flowed toward the main chamber MC (that is, the opening AP).

[0024] In the apparatus having the construction described above, as shown in Fig. 3, the chamber controller 100 controls the temperature adjusting units 10 and 20 independently or separately based on the detecting results of the temperature sensor 30 and the environmental sensors 16, 26, thereby making it possible to arbitrarily set the temperature of the gas which is circulated in each of the chamber rooms MR, SR. Therefore, the glass plate, in the plate carrier PC_1 stored in the sub chamber SC, for which the exposure process to be performed is kept as a stock, and at the same time, the temperature of the glass plate becomes balanced to a temperature which is substantially same as the air temperature in the chamber room SR, namely the temperature of the plate stage (to be precise, temperature of a plate placing surface (holder surface)) in

the exposure processing section PE. Accordingly, when that the glass plate in the plate carrier PC_1 is loaded on the plate stage, the temperature difference between the glass plate and the plate stage (holder) has already been zero and any size change of the glass plate does not occur on the plate stage. Thus, it is possible to start the exposure operation immediately.

[0025] In the embodiment described above, the two pieces of plate carriers PC_1, PC_2 and the plate loader PL are accommodated in the sub chamber SC. However, only a carrier, among the two carriers, in which the glass plate to be loaded to the exposure processing section PE is accommodated, may be accommodated in the sub chamber SC. For example, in a case that the glass plate accommodated in the carrier PC_1 is to be accommodated again in the same carrier PC_1 after the pattern has been transferred onto the glass plate in the exposure processing section PE, it is allowable that only the carrier PC_1 is accommodated in the sub chamber SC. In this case, the constitutive parts or components other than the carrier PC_1 are accommodated in the main chamber MC. Further, in a case that a stepper and a coater-developer are in-lined, it is allowable to provide such a configuration that a glass plate having a resist layer formed on a surface thereof is loaded into the main chamber via the sub chamber. In the case that the stepper and the coater-developer are in-lined as described above, a

holding member (for example, a buffer cassette, etc.) for adjusting a transport time of the glass plate is provided in a transport route, and thus the buffer cassette may be configured to be accommodated in the sub chamber.

[0026] Further, in this embodiment, the temperature of the glass plate is controlled depending on the temperature of the plate stage (holder). However, for example, in a case that the change in the temperature of the plate stage is small, it is also allowable that the temperature of the glass plate is controlled always at a certain value, namely at a predetermined temperature which is within a range of the change in the temperature of the plate stage. Further, it is unnecessary to control the temperature of the glass plate to be substantially same as the temperature of the plate stage. It is allowable, for example, to control the temperature of the glass plate to be within a temperature range such that the amount of size change in the glass plate, caused by the temperature difference between the glass plate and the plate stage, is within a predetermined acceptable or permissible value (a value determined unambiguously by the alignment accuracy, stitching accuracy, etc.).

[0027] Further, in this embodiment, the temperature-controlled air is circulated in the sub chamber SC so as to control the temperature of the glass plate to a desired temperature. However, other than this method, it is also

allowable to employ the following method including, for example, heating (or cooling) the glass plate or the plate carrier (or the buffer cassette), accommodating the glass plate to be loaded to the exposure processing section, with a temperature adjusting means such as a Peltier element etc., to thereby control the temperature of the glass plate or the plate carrier (or the buffer cassette). In a case that such a configuration is adopted, it is not particularly necessary to provide the sub chamber, and the plate carrier PC_1 can be accommodated in the main chamber together with the exposure processing section PE, etc. However, in view of the accuracy of the temperature control of the glass plate, it is desirable that at least the carrier PC_1 is arranged in the sub chamber. Note that, the gas which is made to circulate in the sub chamber SC may be a gas different from the air, for example, such as helium, etc. Further, instead of using the manner in which the temperature-controlled gas is circulated, it is allowable use any fluid (water etc.) other than the gas in a case that only the temperature of the glass plate is controlled directly or indirectly.

[0028] Further, in a case that a sequence in which a next glass plate to be processed next after a certain glass plate is made to stand-by in the load arm 73 during the exposure operation for the certain glass plate is adopted in order to realize a high-speed exchange of the glass

plates, it is desirable to set the temperature of the next glass plate in the sub chamber SC to be higher to some extent in advance by taking into consideration the stand-by time in the load arm 73. Further, in the embodiment described above, the temperature in the sub chamber SC is set to be substantially equal to the temperature of the plate stage PS, to thereby make the temperature of the glass plate PT be balanced to the temperature of the plate stage PS. However, it is allowable to actively control the temperature in the sub chamber SC (namely, the temperature of the air subjected to the circulation) so as to make the temperature of the glass plate PT be equal to the temperature of the plate stage PS in the minimum time, in the following manner. For example, the temperature of the glass plate PT is set to be higher to some extent than the temperature of the plate stage PS immediately after the plate carrier (or the glass plate) is accommodated in the sub chamber, and then the temperature of the glass plate PT is set to be substantially equal to the temperature of the plate state PS at the point in time at which the temperature of the glass plate PT is substantially equal to the temperature of the plate stage PS.

[0029] Further, it is also allowable to provide a temperature adjustment mechanism in the plate stage PS and to perform control such that the temperature of the stage is always constant. In this case, there is an advantage

such that the temperature control in the sub chamber SC (to be precise, the temperature control of the glass plate) is performed very easily. To perform the temperature control more actively, it is allowable to control the temperature of the plate stage depending on the temperature of a next glass plate to be placed on the plate stage next, so as to make the temperature difference between the next glass plate and the plate stage substantially zero. In this configuration, it is allowable that the temperature of the next glass plate to be placed on the plate stage is controlled at a predetermined value by the sub chamber etc.; alternatively, it is allowable that the sub chamber, etc. is/are not provided and that the temperature of the next glass plate to be placed on the plate stage is not be controlled at all.

[0030] Although the embodiment described above is focused on the temperature difference between the glass plate and the plate stage, there is a possibility that the exactly same problem might arise between the reticle and the reticle stage. Therefore, the temperature of the reticle may also be controlled at a predetermined value before the reticle is transported to the reticle stage. Also in this case, exactly as with the embodiment described above, it is allowable to provide a configuration wherein a storage section (including a reticle case, etc.), in which

a reticle to be transported to the reticle stage is stored, is accommodated in the sub chamber, separately from the main chamber MC, while being substantially shielded from the outside air; and the temperature of the storage section is controlled at a predetermined value. Alternatively, it is allowable to control the temperature of the reticle directly; or in a case that the stepper and a stock system in which hundreds of pieces of reticles are storable are in-lined, it is allowable to provide such a configuration that the temperature of the reticle is controlled in the stock system.

[0031] In the present invention, the construction of the main chamber (the first chamber) and the temperature adjustment mechanism in the main chamber may be arbitrary. Further, the exposure processing section PE may be a type other than the projection type. For example, the exposure processing section PE may be of the proximity system, etc. Furthermore, the present invention is applicable, in exactly the same way, to the exposure apparatus for producing the semiconductor.

[0032]

[EFFECT OF THE INVENTION]

As described above, according to the present invention, the photosensitive substrate before being transported to the exposure processing section (substrate stage) is accommodated in the second chamber, separately from the

first chamber in which the exposure processing section, etc. is accommodated, while being substantially shut off from the outside air, and the temperature of the photosensitive substrate is maintained at the optimum temperature. Accordingly, it is possible to obtain the effect that a time after the photosensitive substrate has been loaded in the exposure processing section and until the temperature of the photosensitive substrate is stabilized (namely, the photosensitive substrate is in the thermally equilibrium state) can be shortened. Further, the temperature in the second chamber, namely the temperature of the photosensitive substrate, is actively controlled depending on the temperature of the exposure processing section (substrate stage), thereby making it possible to set the temperature of the photosensitive substrate to be substantially equal to the temperature of the exposure processing section (substrate stage) in the minimum time, which in turn makes it possible to improve the throughput of the exposure apparatus. In this situation, the amount of the size change of the photosensitive substrate is within the predetermined acceptable value or is substantially zero. Therefore, it is also possible to prevent the decrease in the alignment accuracy and/or in the stitching accuracy which would have been otherwise caused due to the above-described size change.

[BRIEF EXPLANATION OF THE DRAWINGS]

[Fig. 1] Fig. 1 schematically shows an overall construction of an exposure apparatus according to an embodiment of the present invention.

[Fig. 2] Fig. 2 shows an example of a specific construction of a sub chamber (second chamber) shown in Fig. 1.

[Fig. 3] Fig. 3 is a block diagram showing an example of construction of a controller of the exposure apparatus, particularly of two pieces of chambers, according to the embodiment of the present invention.

[Fig. 4] Fig. 4 is a plan view of a specific construction of an exposure processing section.

[Fig. 5] Fig. 5 is a perspective view of a specific construction of a substrate transport section (plate loader).

[EXPLANATION OF REFERENCE NUMERALS]

10, 20	temperature adjusting unit
11, 21	fan
12, 22	HEPA filter
16, 26	environmental sensor (temperature sensor)
30	temperature sensor
PE	exposure processing section
PL	substrate transport section
PC_1, PC_2	plate carrier
100	chamber controller

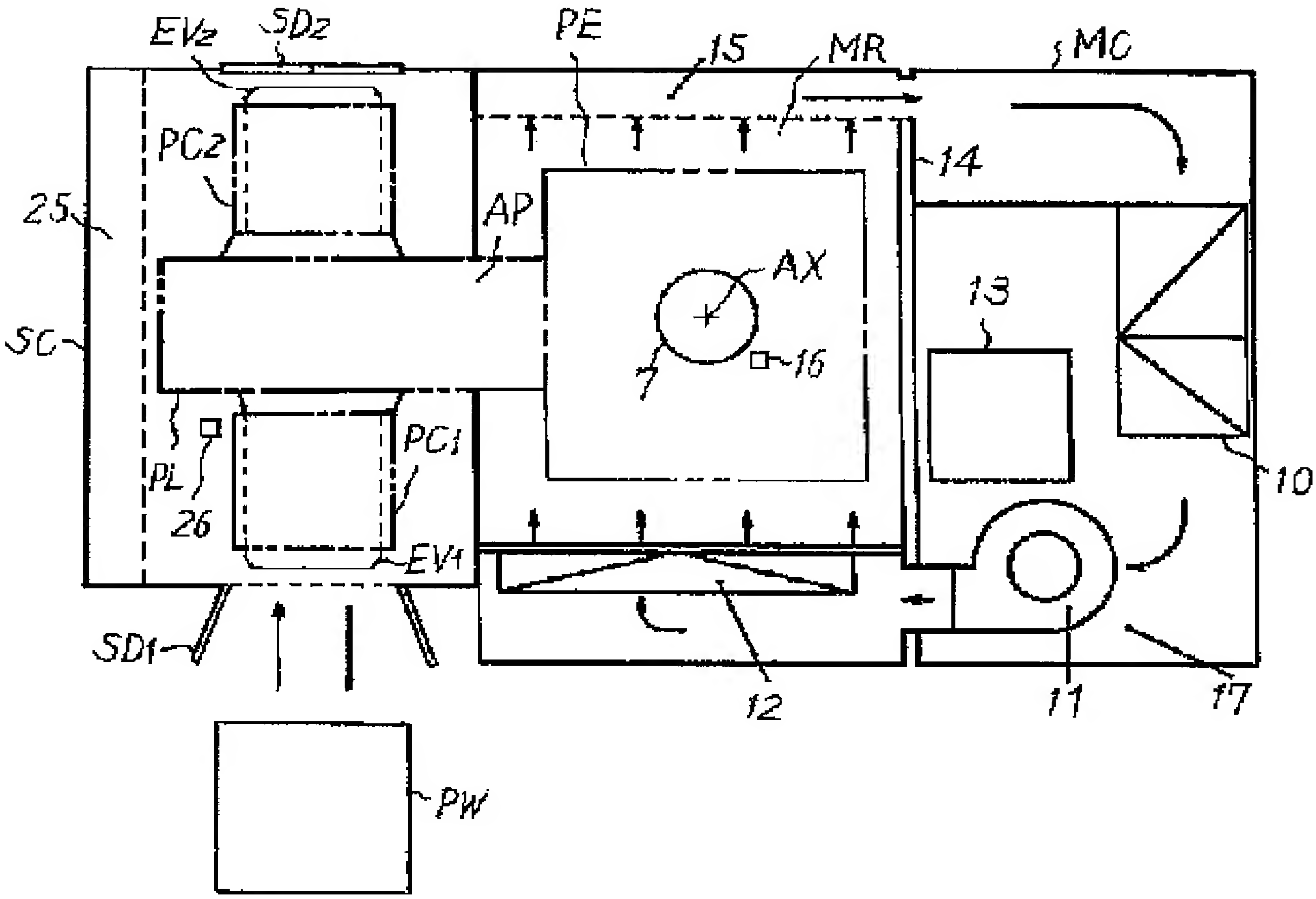
(57) [ABSTRACT]

[OBJECT] To improve the throughput of an exposure apparatus.

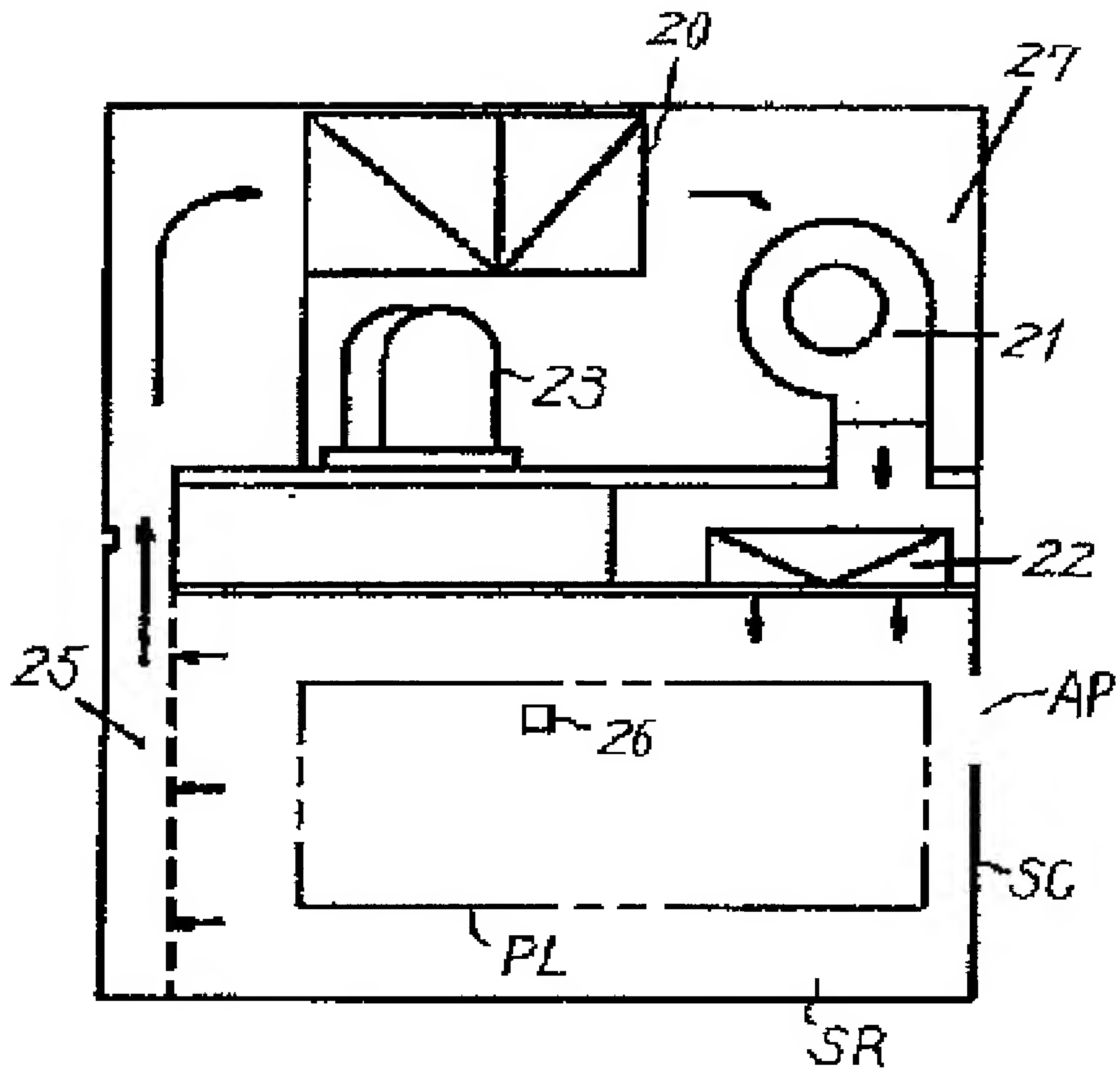
[CONSTITUTION] A plate carrier PC_1, in which a glass plate PT to be loaded to an exposure processing section PE is accommodated, is accommodated in a sub chamber SC, separately from a main chamber MC in which the exposure processing section PE provided to transfer a reticle pattern onto the glass plate PT is accommodated while being substantially shut off or shielded from an outside air. A chamber controller 100 controls an environmental condition in the sub chamber SC, particularly the temperature in the sub chamber SC, to set the temperature of the glass plate PT in the plate carrier PC_1 to a predetermined value.

[EFFECT] A pre-loading temperature of the glass plate PT, which is to be loaded into the exposure processing section, can be set to an optimum temperature, namely substantially same as a temperature of a plate stage PS. Accordingly, it is possible to immediately start an exposure operation with respect to the glass plate in the exposure processing section.

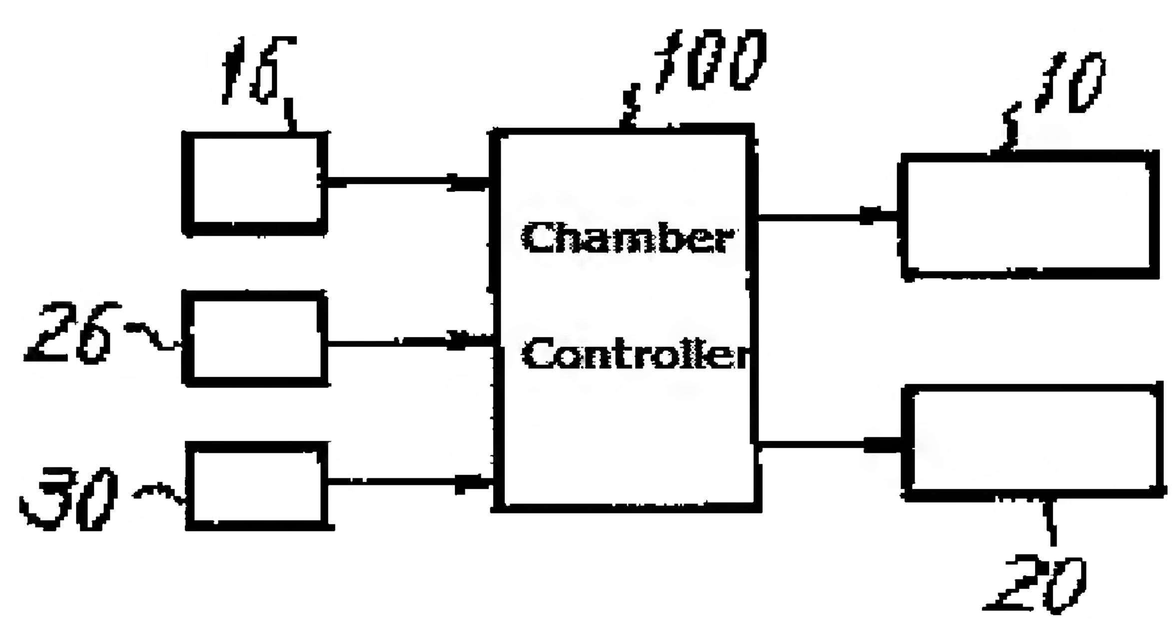
[Fig. 1]


EV2
SD2
PE
15
MR
MC
PC2
14
25
AP
AX
13
SC
16
7
10
PL
PC1
26
EV1
SD1
12
11
17
PW

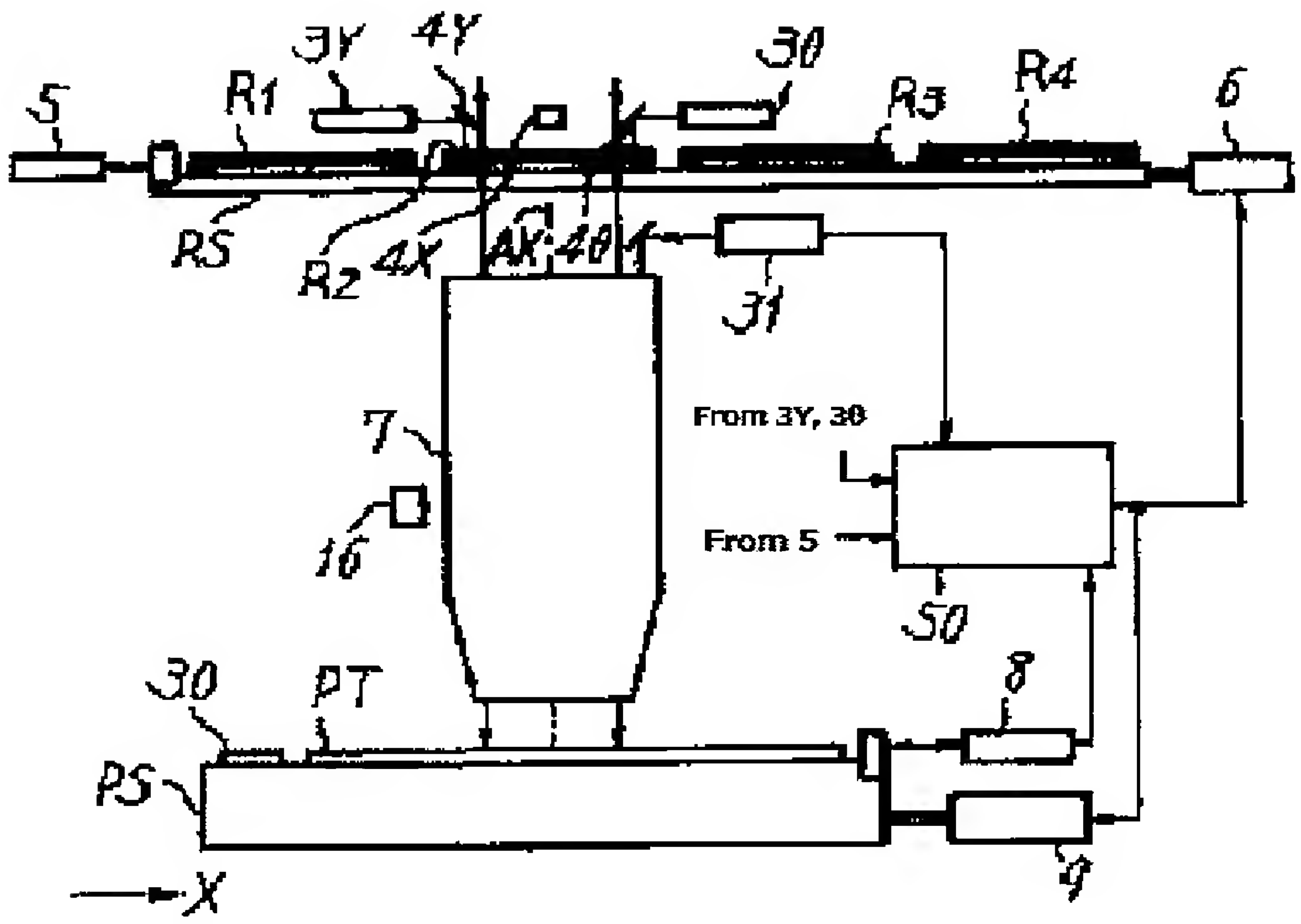
[Fig. 2]


20
27
21
23
22
25
AP
26
SC
PL
SR

[Fig. 3]


16
100
10
Chamber
Controller
26
30
20

[Fig. 4]


5
R1
3Y
4Y
30
R3
R4
6
RS
R2
4X
AX
40
31
From 3Y, 30
7
16
From 5
50
30
PT
8
PS
9
X

[Fig. 5]